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Support Mission
RUMINANT FEEDING AND FODDER PLANTS
at the Livestock Research Unit, Halhale, Erythrea

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Résumé

La mission effectuée auprès de l'unité de zootechnie du centre de recherche agricole de Halhale était commanditée par le SCAC - MAE Erythrée

L'objectif était d'établir les premiers éléments d'un programme de recherche commun entre le Cirad - emvt et les chercheurs en production animale du centre. Le programme de la mission était principalement axé sur les aspects cultures de fourrage qui pourraient être développés en partenariat sur la station de Halhale. La mission envisageait également l'appui rapproché à un stagiaire Cnearc effectuant une étude à caractère typologique sur les exploitations associant agriculture et élevage sur le plateau central.

L'institution est récente et fortement demandeuse de soutien tant en moyens qu'au plan scientifique. La thématique agriculture élevage pourrait être un axe de collaboration intéressant et structurant, si des moyens et un programme de soutien régulier se met en place en marge du FSP MAE, qui se construit principalement sur l'appui aux services de suivi sanitaire des animaux.

Summary

This support mission for the livestock unit of the research centre of Halhale was ordered by the MAE SCAC in Eritrea.

It aimed to establish the bases of a common research program between Cirad Emvt and the scientists in animal production of the centre The program was oriented on the aspects of forage production that could be developed in partnership with Halhale centre. It was also oriented to the backstopping of a French student from Cnearc working on a study on the typology of the mixed farming systems on the Central Plateau zone.

The institution is quite recent and highly demanding scientific support and experimental means. The livestock agriculture interactions could be an interesting collaboration axis in the perspective of a reinforcement of the support that could be developed along the FSP French MAE that is on his way mainly in support of animal health problematics.

CONTENT

Acknowledgements

At the end of this backstopping mission, I would like to reiterate all my thanks to the livestock research team for the interesting presentations and stimulating discussions on the work undertaken at the of the Halhale centre. More particularly, I would like to address my special thanks to Dr. Tseggai Tesfai and to M. Airrault and P. Montaigne for the welcome.

Introduction

In the aim to support the country in strengthening the livestock agricultural sector and improve food security, the SCAC[1] of the French Embassy in Eritrea allocated an initial funding in the 2003 budget (Titre IV), to start cooperation activities in the fields of livestock production, health and research. This cooperation action is a first step in the construction of a partnership between French and Eritrean institutions and could lead to further activities in a possible future pluri annual programme. The Mission focused on the research support in ruminant feeding and fodder plants at the Livestock Research Unit of the Halhale centre.

Objectives of the mission:

To propose and elaborate a research work plan jointly with Eritrean scientists of the Research Centre of Halhale

- Evaluate the possibility to introduce and test forage plants in controlled experimental trials; the relevant staff of the Centre willing to conduct this activity this year in the Centre.
- To supervise a study of the farm feeding practices in the crop livestock systems of the highlands; this study will be realized by students in training and young scientists (the TOR of this study are in annex 1).

[1] Services de coopération d'action culturelle

General context

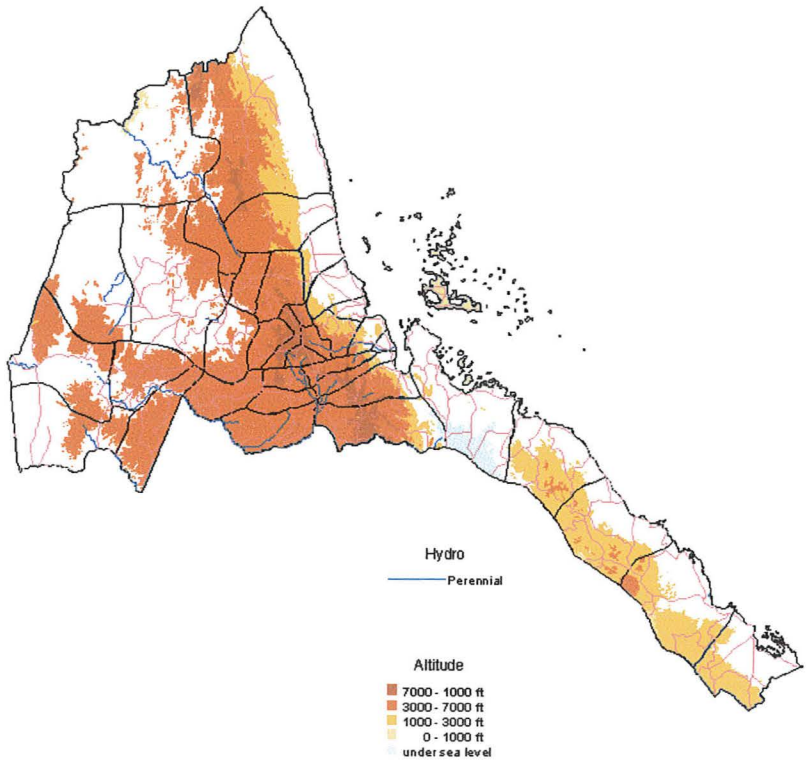
A very well detailed scope on the agro ecological context of the country and on the forage resources potentialities can be found since recently on the FAO site : Pasture and Forage country profile databases[2]. It is a precious reference as far as descriptive literature on these subjects in Eritrea is actually quite limited.

Very succinctly, mainly after the description made by Kayouli, Tseggai and Tewolde (FAO, 2003) and according to the observations made during the field tours and farm visits, the main features on the context and problematics on which the mission had to take interest can be summarised as hereafter.

General features

In Eritrea (117.600 km²), altitudes vary from below sea level to over 3,000 m. In the central part, the Highlands zone separates the country between its eastern and western lowlands zones (see maps). The climate ranges from hot arid in the coastal plain areas, to temperate sub-humid in the highlands. Altitude is the major factor determining temperature and rainfall. The climate of about 70 percent of the country is of arid type with total rainfalls below 400 mm and temperature > 26° C.

Relatively to the rest of the country, the Central Highlands (rainfall 400 - 600 mm), offers the best conditions for rain-fed crops productions. The population of Eritrea (4 millions inhab.) is mainly rural, 65 percent of the population lives in this area.



[2] Chedly Kayouli, Tzeggai Tesfai and Assefaw Tewolde http://www.fao.org/ag/AGP/AGPC/doc/Counprof/Eritrea.htm

Fig 1 Eritrea main topographic features[3]

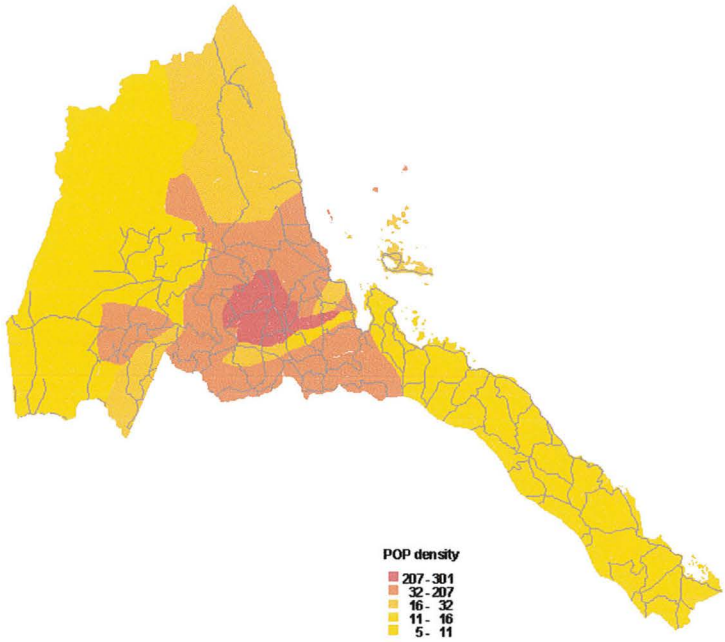


Fig. 2 Eritrea population densities.

The main food resource for the population, comes from the cereal cultivation in mixed systems generally associating draft animals. Rain fed cultivated land accounts however for only 5 % of the total land surface The lowlands are quasi exclusively oriented to low input pastoral livestock production.

In this recently independent nation, the steady increasing population pressure (2,9% yr^{-1}) combined with poor land management policies in the past, resulted in serious land degradation. Moreover in the recent years the country has known important decrease in annual rainfall and recurrent droughts, limiting the agricultural potential and the feeding self sufficiency of the population. Figure 3 elaborated according to long period databases is at this point of view quite explicit, it presents the actual annual rainfall level (near 400 mm). Against the general tendency in the past, looking at the cycles it could be considered with some hope that we are at the lowest in a phase going slowly back to a better situation in the future.

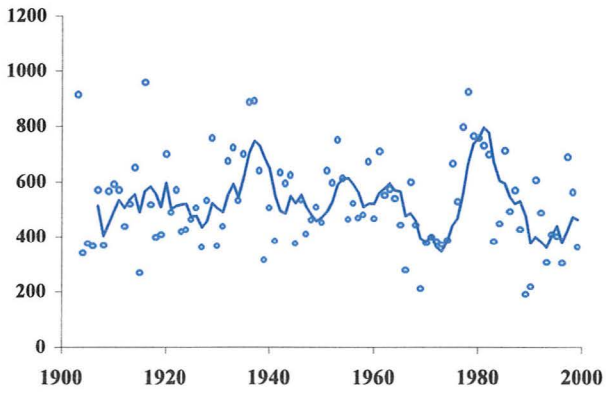


Figure 3 General trends in total annual rainfall, mm $yr^{-1,}$ yearly records and mobile mean on 5 years, [4]

[3] Mapinfo, general layout extracted from GIS internet data base

Between extreme situations, figure 4 shows the monthly rain repartition and the average very narrow (3-4 months) opportunity for cultivation and by the way forage biomass potential availability in the natural conditions of the Highlands.

The nation is still largely dependent on international food aid and faces important needs to adapt and improve the agricultural production.

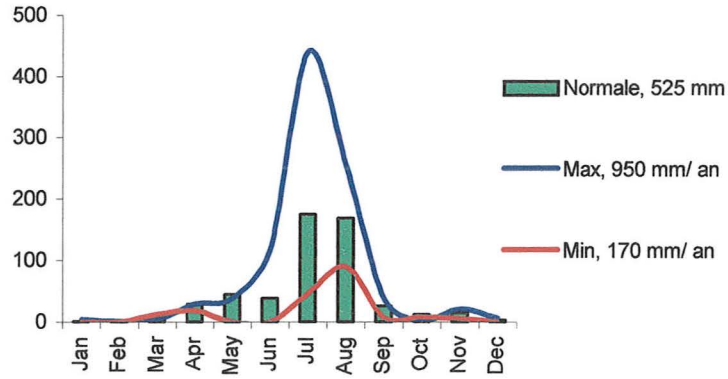


Figure 4 Monthly rain distribution in Asmara, bars are normal mean distribution, the curves show the high variability that can be encountered [5]

Livestock is by the way an important resource for the country, with >2.2 millions cattle, 1.4 sheeps and 1.7 goats[6] it accounts for 25% of the agricultural GDP. It is the only activity for the pastoralist and agro-pastoralist in lowlands and represents significant part of the country's export resource. It seem by the way to offer a really promising opportunity for foreign exchange to Middle East Countries. Livestock has also a significant role in the socio-economical life of rural population for draft power, food security, manure & on-farm savings and it is closely integrated with crop productions in the highlands. There is also a growing urban market demand for milk, meat and eggs which are partly supplied by small-scale commercial livestock producers.

The Lowlands are the livestock reservoirs of Eritrea. About 2/3 of the cattle and goats are in the western lowlands. On the central highlands, the draft oxens constitute over 50 percent of the on farm cattle.

Livestock implication in the agricultural context

Most of the agricultural production is in the Central Highlands, the South-western Lowlands and parts of the Coastal zone.

As seen during the farm visits, in the Central Highlands (alt. 1500 m, ≥ 500 mm, rainfall) smallholders (≤ 1 ha) produce mainly wheat, barley, sorghum, teff[7] , legumes ... They depend largely on animal power for ploughing and threshing. Small ruminants are reared for meat and milk and as a source of cash. There are communal grazing areas and seasonal migration of cattle herds to the lowlands, when grazing shortage takes place in the highlands. A minority

[4] After data's (1903-2000) from FAO Worldwide agroclimatic database, FAO clim 2 ver 2.01 FAO agrometeorlogy goup, Rome 2000

[5] idem fig 3

[6] FAO statistics 2002

[7] *Eleusine corocana*

of producers invest in irrigation (wells and motor pumps) and produce vegetables (potatoes, tomatoes, onions..) on part of their land.

Rainfed farming being the main agricultural activity on the central plateau, annual crop production is the major preocupation. The main feed resources for herd keeping are communal grazing land, shrub lands and the crop residues.

The increasing population pressure lead to convert more natural grazing land into crop land. It leads also in a higher demand for draft animals in a situation where the forage resources are limited. More oxens have to be retained on the restricted available land, limiting by so the number of cows and other animals that can be fed on the natural resources.

In the South Western Lowlands, (alt. 600 - 750 m; ann. rainfall 500 - 700 mm) the majority of the farmers are agro-pastoralists, at various degrees of transhumance. It goes from nomadic associated herd keepers (camels, cattle and small ruminants), to semi-sedentary agro-pastoralists associating livestock keeping to occasional/itinerant cultivation of sorghum or pearl millet; or to all year round sedentary producers practising mixed crop/livestock production. By the way medium and large-scale commercial farmers have been promoted by Government distribution of land and the availability of capital.

Some parts of the Coastal Plains have a potential for crop production. These are in the Eastern Lowlands where irrigation is possible. The main activity remains rearing of mixed herds of camels, cattle and small ruminants with seasonal migrations towards the highland areas in the hot dry season. An important activity for the population of this zone is the sorghum growing using short duration spate flood flows diverted into the fields with species similar to muskwa'ari in subsahelian zones of west africa.

Most of the livestock in the Western Lowlands are raised on natural grazing under pastoral and agro-pastoral systems. In this area, the traditional practice is to use humid and dry season camps, migrating between low and higher land zones. Conflicts regularly appear between pastoralists and farmers due to animal crop damage and due the fact that cultivation activities progressively blocks the traditional livestock routes.

All these quite traditional farming systems remain essentially characterised by low input/output features and mainly aim at subsistence.

Dairy activities

Another important livestock activity is the peri-urban dairy production systems. Dairy is a long tradition (introduced by Italian settlers). The commercial dairy industry has deeply suffered during the war, after independence, activities restarted with the support of the Asmara Dairy Farmers Co-operative Association (ADFA), which owned a milk processing plant and a feed mixing plant, and organized milk collection and feed distribution. The dairy production is basically concentrated in urban and peri-urban zones of Asmara. The situation of the peri-urban dairy chain is however quite difficult. Most producers have lost their forage producing farms and retreated to the urban area. The farms now operate through the purchase of hay and straw from farmers and by-products from the industry. The nutritional condition of the animals appears poor and milk yields are quite limited. During a survey on the peri-urban dairy sector (Kayouli and Assefaw, 1999), pointed out that inadequate feeding is the basic cause of low milk production (1,173 litres/cow/yr) and poor herd reproduction parameters. Milk yield per lactation being still far below the genetic potential of the Holstein Friesian cows and other improved breed introduced in the past.

However as seen during the visits, young entrepreneurs associated in dynamic producers organisation invest in innovant intensive systems (irrigated forage production, milk storage forage facilities and milk distribution chains)

Nutritional constraints

As in many situations in East Africa as well as in West Africa, among the multiple constraints limiting the potential development of livestock production, feed resource production and animal feeding can be identified as major limitations. This is particularly effective in the very limited rainfall context of Eritrea even in the Highlands. The main feed resource comes from the very limited biomass of the natural pastures, and during long dry periods from straw and other agricultural residues which are often of poor quality. This shows also how strategic the crop by products are for livestock.

In most areas, especially during the dry period, maintenance requirements of the cattle are very probably not met during at least six months of the year. (see fig. 4) The animals are submitted to chronic under nutrition, losing weight in the dry season and early wet season, this makes them more vulnerable to diseases. Poor nutrition affects the oxen performance at work and limit agricultural productivity improvement.

Other constraints can also be identified, it is mainly: the shortage of know-how among trained technical personnel and limited practical skills of smallholders. The livestock sub-sector as well as the cropping system are primarily smallholder based. Inside these systems the livestock and agricultural management practices remain very traditional using quasi no external inputs or innovative management practice derived from technical advice. The agricultural extension services appear still quite weak, lacking of qualified extension people.

This shows all the importance to accompany in this very young independent country the building of a well structured network of research and development activities for the production and extension of local references and adapted innovant models for the future.

An on going administrative structuration

Facing all these constraints, the Ministry of Agriculture is pursuing its structuration into 3 main departments: Agricultural Promotion and Development (APD) department, mainly oriented to extension work, the Regulatory Services department (RSD) for the standards and norms control and the Agricultural Research and Human Resources Development department (ARHRD). This recent evolution, still to be confirmed by a law decree, will clearly separate the management of extension services and research activities.

The Regulatory Services department include the Animal Health services and the National Control Laboratory services[8] on which an important collaboration program is taking place with the support of the French Embassy SCAC services.

The ARHD department manage the agricultural research and human resources formation activities in Eritrea. Inside the department Agricultural Research is organised in five main Research Unit: Agriculture / Horticulture / Forestry / Agricultural engineering and Livestock.

Three main research centres are located in the main agroecological zones of the country. The Halhale Centre located in the Highlands is the main research Centre. The two others are the Sheab center in the Coastal plains and the Shamboko in the Gash Barka zone.

[8] This laboratory has been has been financed by Danida and along to health control has also all cpapbility to undertake feed evaluation,

Regarding the extension and the R&D relations, on an administrative point of view the country is divided into 6 Zobas (Central, South, Northern Red Sea, Southern Red Sea, Ansheba and Gash Barka). Each one is relatively autonomous and has its own development scheme according to the local natural resource and the ecological particularities. A representative of the ministry of agriculture is in charge of the activities of the different main departments and research has to work in narrow collaboration with the local representatives for any field activities.

The APDD (Agricultural Promotion and development department) gather the technical advisory services (> 20 persons). It is a new department, the final organisation appeared not totally established and information on exact competencies and extension work policy still need to be defined. The APDD support actions on bee keeping, dairy poultry and meat systems. It works in connection with the ABD funded Livestock Development Project, apparently mostly oriented on pastoral zones livestock support[9], it has also important links with the interesting Dairy Communities[10] project in the Ansaba Zoba. Danida has however recently suspended fundings to the project and APDD and dairy farmers association have to rely on local credits to pursue the on going action.

Actually all these structures are young, still building up and there remain an important effort to do to coordinate the competencies and achieve a really efficient and collaborative R&D activities network.

General problematic

The country is young and rely mainly on it's own agricultural population activities to reach progressive self sufficiency and eventually develop exportation capacity. On this last point if the crop production will remain deeply constrained by land availability, climate conditions and huge internal needs, the livestock production appears effectively as an important potential sector that need to be supported.

Along the organisation of the animal health services actually supported by the French Embassy, an essential component for the exportation capability of the country; it is evenly important to support an emerging research system in it's efforts to improve the livestock production, develop local references and improved models for the emerging agricultural extension system.

On the Central plateau zones, on which the actually initiating French livestock research support program has to focus in accordance to the wishes of the Halhale Centre, livestock appear particularly in competition for the land, and dependant or associated to crop cultivation, the main agricultural activity.

As far as like in other zones of the country, animal feeding appears as a major constraint it is important to pursue a specific research effort on the improvement of the production and management of alternative local feeding resources.

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[9] Report of Bruzon (2002) on the specific activities of the project were still not available at the time of the mission..

[10] The project is to develop 3-4 comunities of farmers around milk production, the most important one is based in Keren (N-W of the highlands) the Dairy community groups 76 households each one has a shade for 1-2 cows altogether they share 80 ha of land to be irrigated for the cultivation of Napier and alfalfa, a truck collect the milk that is delivered in a cooling center, packed and then delivered as raw milk in a retail shop in Keren. Actually the total herd counts 166 hds, with 96 dairy cows producing 9-10 l/d. Due to lack of credits, only 18 ha are actually irrigated, and the farmers are facing important forage resource shortage.

Considering, the particular agro ecological and highly populated context on the Plateau and the assessment shared internationally on the necessity to improve On the one hand the relations and reach a better integration between crop and livestock systems as a main way to improve the efficiency of the systems, on the other to take a better account of the farmers diversity, their perception of the problematics and the potential solution it would certainly be interesting to reinforce links and partnerships between the Halhale research centre and technical/scientific international expertise to jointly develop more integrated approaches.

In this scope the mission put a particular interest on the forage research work actually developed inside the station and on the approaches that could be developed in terms of crop livestock systems improvement.

Livestock research at the Halhale centre

An important research program has already been implemented in the recent years. It was and appeared during the mission, to be still supported by FAO in the frame of the project initiated in 1996 for "Strengthening the agricultural research and extension in Eritrea" (GCP/ERI/001/ITA) and more particularly inside the component "Appropriate research and development program in animal nutrition" of this support project.

Inside this project, important efforts have already been developed to implement research activities on forage production/valorisation and nutritional supplementation of the animals. By the way important fundings have been allocated to develop a nutrition laboratory inside the perimeter of the Halhale centre.

During the year 2000, the national mobilisation deeply slowed the project research activities and suspended the external scientific support. Actually, 10 people are dealing with research under the supervision of the head of the livestock section, the young graduates recruited in the frame of the national service with the help of the senior scientists try to reinitiate the research activities.

Contacts are also reactivating between the Halhale research centre and the new FAO representative in Asmara, to consider the pursuit of the previous activities. An FAO backstopping mission on nutrition research activities could be planned before the end of this year.

Concerning the laboratory facility development, all the analytical equipment has been acquired on behalf of FAO fundings and the building is nearly completed on funds provided by the state. It however still needs electrical and water connection and most over the furniture and equipment (lab tables, desks, office supplies ...) to be able to install the analytical material. Funds have been budgeted by the agricultural administration, due to economic situation and the necessity to help the farmers this year after the drought of 2002 it won't probably be realised before the end of this year.

This compromise the initially SCAC forecasted support mission for the starting of the laboratory and the methodological training of technicians on laboratory methods

The actual Forage and Animal Nutrition research

After the discussions with the researchers and according to the largely detailed descriptions provided in the most recent report of Dr Chedli Kayouli[11] (2000), an internationally well

[11] Dr Kayouli is also the actual expert commited to the Livestock Development project at APDD.

recognised expert, who was and will very probably continue to support the nutrition research program on behalf of the FAO project, the main topics that have been implemented till now can be listed as follow.

Two programs tend to implement forage conservation and feeding supplementation technologies to the local conditions.

- Manufacture and utilisation of multinutritional feed blocks for cattle and small ruminant supplementation;
- Manufacture and use of urea treated straw for forage complementation of the herd during the dry season;

Two are more applied research approaches.

- performance testing of local sheep fed Koshia[12] compared to a classical feeding with natural vegetation hay.
- performance of Eritrean Hassani Dairy Goats fed urea treated straw or Napier Grass as basal diet.
- A particular survey had been also been planned for farm trials and monitoring of the dairy production systems.

Finally, a programme is actually pursued on the Halhale station for forage research and development for annual and perennial forages (see further).

All the initiated activities have been at different degrees deeply slowed down or stopped in 2000. These are progressively rebuilt with the very limited local means.

Considering all these research topics and the fact that for the most these are still on their way and need to be finalised, considering the effectiveness of the development work already done (ex nutritional blocks, urea treated straw,..) when visiting the Centre experimental farm; even if in some way the approaches could appear quite classical "on station research" when looking to what has already been done and published internationally, a strong recommendation would however be to pursue this initiated work. It participate to the local highly needed scientific background and to the establishment of local references on the different subjects. It also really participate to the training of the young scientists that are progressively joining the livestock research team and by so contribute to the building of a national expertise pool on the livestock nutrition constraint alleviation.

The evident good will of the young scientists, the numerous methodological questions they addressed during the mission on protocol building, statistical data treatment and their scientific and informative literature demand[13], show at the evidence that the scientific collaboration and support program supported by the SCAC is totally welcomed and particularly useful to help the research system become more efficient.

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[12] a legume adapted to the dry zones, introduced from Mexico. It could have an interesting forage potential, but it has to be carefully managed as far as it is considered as a major invading pest in many agricultural systems.

[13] In advance on the provision of documentation funded by the SCAC, two personal books: Field and Laboratory Methods for Grassland and Animal Production Research, Forage Evaluation in Ruminant Nutrition, and a the regional flora of Djibouti have been left in Halhale during the mission for the livestock research team.

Forage research

Concerning more specifically the forage production research program, the actual activities focuse mainly on Elephant/Napier grass (*Pennisetum purpureum*) and Alfafa, lucerne (*Medicago sativa*) these two major forage plants were introduced during the Italian period in the large industrial farms. Both forages have a large potential under irrigation in the Central Highlands Zones and the Western lowlands agroecological conditions.

Essentially in the dairy production systems, a limited number of farmers continue to traditionally produce alfalfa and elephant grass under irrigation. It is by the way the main forage system promoted in the dairy communities projects of Keren in the zoba of Ansaba.

In 1999, for the purpose of feeding trials on intensive milk production from goats and cattle, and performance testing on sheep, large productive experimental plots of alley cropping of Pennisetum and *Leucaena* have been established[14] near to the livestock farm of the Halhale research station:

The forage plots are still well established, properly cultivated and maintained, with cutting frequency of approximately a month. It provides part of the forage for the feeding of the small milk herd of the farm.

The data that it produced have not really been exploited as far as the dataset was incomplete (in 2000, the war stopped temporarily the experiment, the follow up ended in mid 2001). As an example and a demonstrative exercise, during the mission these data were revisited with the young researchers. Even if the approach remain scientifically very limited the data's were interesting to describe in the context of the highlands the average forage resource productivity variation along the year. It put in evidence all the importance of the feeding constraint in the highlands, even if here the forage was irrigated for the purpose of milk production systems.

The figure 5 shows the interesting potential of the Napier grass (*pennisetum purpureum),* well exploited the total production for a year could reach a potential of 30 - 35 tons DM / year[15]. However if during the periods going from April – may to November the production is good there is an important limitation of the productivity in winter, even under irrigation essentially due to the colder conditions[16] (fig 6) for this C_4 ,species merely adapted to tropical conditions.

[14] 0.7 ha of alley cropping of Napier grass and Leucaena was planted on July 99 in 8 plots with 36 m × 20 m size. Each plot is make of 24 rows of grass alternating with 6 rows of the Leucaena legume trees.

[15] After an average extrapolation of the daily DM production on the whole year

[16] During the month of jan till march temperature are deeply lowered with occasionnal frost that deeply affect the above ground vegetative parts of the plant.

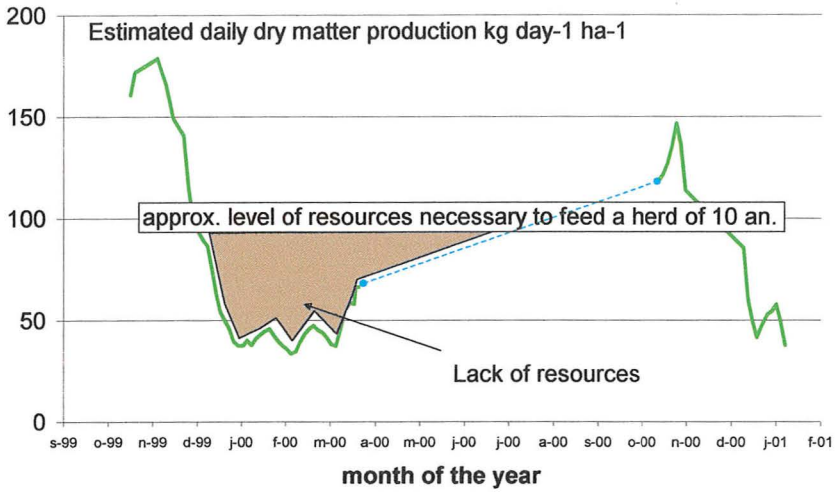

Figure 5, Seasonal daily productivity of the Napier grass against the estimated need of a hypothetic herd of ten 400 kg liveweight cows[17]. (Hal hale experimental plot data 1999 – 2001)

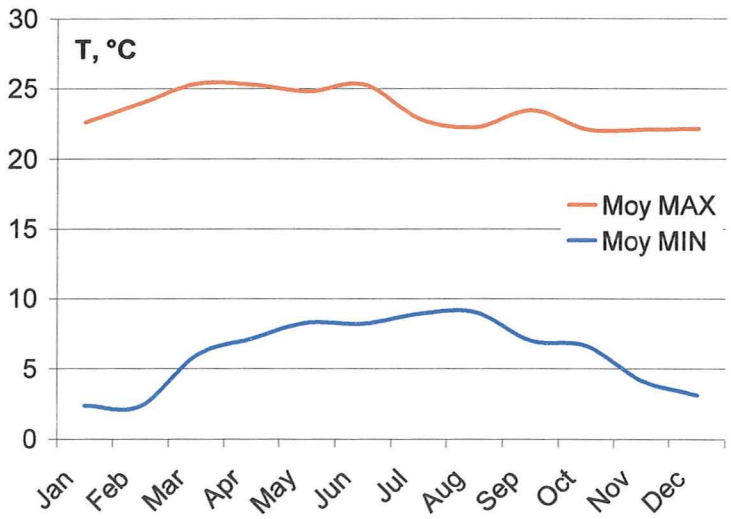

Figure 6, Average monthly Min and Max temperature in Asmara (FAO Data's, 1982 - 1990)

Further than the classical resource productivity evaluation, in a systemic view of a milk farmer resource use facing hypothetic herd needs, it quantifies the resource seasonal constraint. It stress the important diminution (> 50%) of the forage availability against needs, during at least 3-4 months of the year. The data collected in this preliminary experiment in Halhale shows also all the opportunity that can be taken from the excess production during the end of the wet season for hay[18] or silage making. Such description address other forage research questions such as what other species could be more adapted, what kind of itinerary can be adapted to maintain a constant mass and quality forage offer, facing the needs of a herd how can silage making be adapted to smallholder farms etc....

[17] After the data collected every 3-5 days during a period going from oct 99 to april 00, and oct 00 to jan 01 no data collection between the two periods.

[18] Hay would be difficult with generally very low DM pennisetum

The approach remains here still partial and based on incomplete or unprecise data. It should be continued to provide a real farm conditions quantitative description of the resource availability along time and become able to model the overall functioning of improved feeding system.

By the way as far as biomass production is only a part of the nutrition problematic, the feeding quality of the resource should also be described in terms of energetic and protein value of the forage produced. It is not possible for the moment, it shows also all the urgent interest for the Hal hale centre to have an operational nutrition laboratory as soon as possible.

Similar approaches and training have been developed with the forage researcher for the statistical analysis[19], of two experiments on Lucerne cultivation including different levels of mineral and manure fertilisation and forage exploitation. A summary of the analysis is in annex 4.

Recommendations on forage experimentation

- A first recommendation for the forage research team itself would be to pursue the basic observations that can be done on the local available forage resources. Learning by doing is the best way to build the local expertise and ability to manage protocols and to develop well quantified references on the plant behaviour, the potential under different conditions and the main bottlenecks to overcome related to the local environment. These are essential references for the reasoning of future research plan.
- Plot experimentation on forage management practices (fertilising, cutting height,...) are however very classical, many worldwide literature is available on the subject. The recommendation is here to limit these type of testing to the building of the basic necessary local figures and not to spent too much or long term approaches on such "classics" if these are not included in a larger systemic approach at the farm level.

Further than the experimentation on the classical local forages (Napier, Lucerne,) forage testing and comparison of particular or more adapted species could be undertaken at the Halhale centre.

- According to the very large diversity of agroecosystems going from the intensive irrigated forage cultivation to forage improvements in low rain (< 300 mm) pastoral systems, the range of potential adapted resources to test is even large. The Centre has not for the moment all the necessary means to address all the different systems and should focus on the one hand on specific forage management questions in the intensified milk production; on the other hand on questions dealing with a better management of the biomasses in the crop livestock systems and the optimisation of the animal integration in the agricultural practices.
- In the milk systems due to the important pressure in the land, farmers are working on small surfaces and are depending on high yielding irrigated forage. A starting improvement would be to extend as far as possible the biomass potential during the winter periods. This could be partly reached by the cultivation of varieties of Napier more adapted to altitude and cold. In such view, hybrid Napier (Bana grass, *Pennisetum americanum x P. purpureum* hybrids), could be interesting to test as it appear more drought resistant and as sometimes cited in the literature possibly more cold tolerant. Less persistant than Napier, it has however higher potential yield and it

[19] Minitab software of the centre

can be useful for silage making. There are no seed-producing hybrids and like classical Napier, the forage parcels are established by planting stem cuttings, that should be imported from other altitude region of west Africa (Kenya, Ouganda). In a same scope varieties of Guinea grass (*Panicum maximum*) like CV1 could be tested, many other cultivars have been developed in different region of the world (Embrapa,Brasil; CIAT, Colombia, ...;), a survey on the most highlands adapted ones could be recommended. Annex 2 gives an extensive list of forage seed producers and of the main institutions dealing with forage research that could be contacted for the furniture of more specifically adapted varieties for the central highlands. In this scope we particularly recommend to contact the ILRI CGIAR[20] which detain large seed collection and genebanks adapted to the conditions of the highlands. Similar screening approaches could be done on alfalfa varieties for which species CSIRO and Australian seed retailers could be interesting contacts.

- Forage oats – pea or vetch intercropping would also be an interesting alternative to test as it was suggested by Kayouli (2000) in previous FAO expert missions. These temperate species are the most adapted for intercrop cultivation in the winter season, associated in a same field and collected early at the oat pre heading time it can provide interesting supplementary biomass (4 – 5 t DM/ha) with high feeding quality and with potential regrowth potential for oats when water is available. Seeds can be easily purchased on the international market. Related to the observation stated above on the yield reduction on Napier during winter time, oat pea cultivation would find all it's sense.

  As an example of interesting forage research protocol, oat-pea intercrops trials could be established by sowing both crops at a same time at rates less than those usually recommended for grain sole-cropping (a level of 70% of the recommend level is a good rule). Oat should be sown at approx. 100 kernels/m^2 (70 kg/ha) and associated with forage pea sown at 80 seeds/m^2. Barley could also be used for same purpose, and as far as barley cultivation is a classic cereal in the local agricultural practice the two cereals potential could compared in a large protocol. Testing different varieties, the experimental protocol should be designed in total randomised blocks and in four replicates, with individual plots of 1.8 ×6. m.

In a same way many "on station" classical experiments could be designed for the general purpose of resource constraint alleviation in the Central Highlands of Eritrea. There exists also a large amount of literature and non published knowledge in the institutions of the world forage research on such experimental activities. This should be evaluated before to build new protocols.

- As far as the available bibliographic collections at the institute are very limited and as it is a major demand from the researchers to have a better access to scientific international production, we strongly recommend that the specific action for documentation offered by the SCAC be pursued in the future. Actually for the year 2003, a first list of 25 books selected according their priorities by the Hal hale livestock research team, has been collected and will be sent to Eritrea.

[20] For the purpose of adapted varieties to local contexts, Jean Hanson could be the best contact person as manager of the forage genebank at ILRI, j.hanson@cgiar.org

- Internet access to scientific journals and abstract collections would also be a main step for the institution, the DSI services of Cirad could be of help to evaluate the feasability and budget planning for such support arrangements.

Crop and livestock integration in the rain fed agriculture

Even if for livestock research the agricultural system on the central plateau can be summarised in great features like it is described in the "FAO forage country profile" cited above, during the tour in the village and along the discussions with the farmers and scientists there appeared a great diversity of particular situations, practices and relations between crop and livestock keeping. It varies according to time (period of the year) and space dimension, access to and use of land, water, fodder resources and also according to social and organisational constraints on the territory.

In similar agroecological contexts, large differences appear in animal stocking rates, herd structures, and social organisation of the land use on the territory of the village.
At the opposite of the Alfalfa - Napier foraging model for dairy herd, here there is no unique and simple forage resource solution that can be proposed as a model for an ideal crop livestock agriculture. The association between crop and livestock may be close and complex or livestock husbandry and cropping may be parallel activities without interaction, possibly not even belonging to the same management unit (coexistence of agricultural farmer's and pastor's). In the highlands, these systems are very complex and ask for very adaptative solutions elaboration.

Facing the food and protein needs of an increasing population and the necessity of renewed local smallholder agricultural practices, like in many situations on the continent, the improvement of interactions between the systems appear as an important stake as far as land and resource it can afford for livestock are limiting and as the demand for animal keeping is important and will increase in the future.

- Related to crop livestock the research work at Halhale could classically limit itself to adapt new or particular specie to the local environment (ex. Koshia cultivation, stylosanthes varieties testing...) and transfer the improved products to extension. In a more innovant step, it could also in parallel take all opportunity of a more holistic approach and of the presence in a same institution of expertise in the fields of agriculture and livestock husbandry
- Working on the adaptation of exotic or improved species is quite classical and as stated before a lot of approaches have been developed on these subjects it's mainly a matter of information improvement.

In the local systems the main stakes are to improve the biomass potential at the spatial level of the whole territory of the village and to improve the interactions and exchange possibilities around this biomass between the cropping and livestock keeping activities at the scale of the territory.

This cannot be done taking solely the point of view of livestock husbandry or at the opposite, the point of view of the improvement of agriculture without associating the two in a same development scheme.

In the highland cultivation conditions, like in any crop livestock associated systems, all the forage cultivation improvements that can be introduced in the farm for livestock purpose

would have also well known side impacts on soil fertility restoration and/or maintenance and can be very profitable to the improvement of local cultivation systems.

In this view it would be interesting to build research frameworks linking agronomist and animal science expertise in Halhale to develop common research activities on integrated crop livestock systems.

- On the central plateau, a range of technical innovations could be tested. Derived from the principles of Conservative Agriculture, it could include innovant techniques such as mulch cover cultivation, no tillage direct seeding in cover of forage, ley farming ... to overcome some of the crop/livestock issues identified, and as alternatives to low imput/low fertility conditions in the actual cropping systems.

  While contributing to soils restructuring, erosion control and improved crop management, these innovations can also provide important quantities of good quality forage for the livestock. These could be components of cropping systems that farmers can combine and recombine according to their specific needs and objectives (e.g. priority to cereal sufficiency, crop/livestock association, fodder intensification for livestock). A large expertise has been developed inside CIRAD on these innovant techniques and on the positive interactions resulting from the association with livestock. It could be an important common research thematic in future collaborations

Cereal research is important for livestock. Sorghum, mil, millet, are main cereals in the local systems. Cultivated for the grain these produce also important "strategic" amounts of straws that are used for cattle feeding during the dry season. Classically for research these cereals are breeded and tested according to the grain productivity optimum. The "crop livestock" farmer's point of view is however sometimes quite different as far as he considers evenly grain yield for family needs as straw biomass for the feeding of the oxens that will help him to plough the land for the cultivation of the cereal the following year. Even as straw yield, the feeding value of the straw can also be genetically improved, like in maize there exists a large natural variability on these criteria.

- This address interesting question for a research center like Halhale when one consider the existing expertise in the fields of cereal genetics, agronomy, livestock feeding ... Dual purpose cereals could certainly be an innovant research thematic for common future action in response to the problematics linked to the crop livestock systems. On this particular subject Halhale Center could also take all opportunity from exchanges with the dual purpose Sorghum research group in Cirad

Derived from these evocated research approaches, different new livestock-feeding practices could be organized in the frame of innovative food-feed cropping systems whose components should be spatially and timely combined accordingly to the characteristics of the different farm households. Indeed solutions to problems of crop-livestock interactions in the highland region need also to begin with a solid understanding of the multi-faceted livelihood strategies of the farmers involved.

Inside the diversity of the agricultural practices context of the highlands, identifying household groups as potential targets for organizational and technical innovation transfer appear as a first step to improve crop-livestock interactions.

In the frame of the research action "on farm ruminant practices in the highlands of Eritrea" supported by the SCAC, a team of young scientists, two eritreans and a trainee from CNEARC are actually developing a initial approach on these last questions.

Nutrition and forage research and development strategy

Like in many R&D approaches in agriculture, in the particular field of nutrition a major assessment that is now more and more acknowledged by international research is the very limited level of adoption of all the forage innovations that have been developed (Sumberg, 2002). For decades livestock nutrition and animal feeding have been identified as critical constraints, till now producers in low input based systems show however little interest in improved forage and nutrition technologies. A main argument on poor adoption, is that the analyses highlighting nutrition and food as critical constraints, focuse primarily on biological productivity, and are most of the time at odds with the socio economical context and the livestock producers' perceptions.

A major shared recommendation for the future of livestock research is that it should take greater account of the diversity inside the different systems, situations and producers types , as well as of the key characteristics of the technologies to be proposed such as the reliability and management flexibility.

- A same assessment can be done for the future and the effectiveness of the livestock research work at Halhale, a good example is the urea molasses blocks or the urea treated straw technologies developed in the Center. The scientific and technical work done in Hahale on these subjects appears complete, effective and of quality, but the adoption in the farms remain very limited. This is not a criticism as far as a same assessment can be done in most of the institutions/countries dealing with similar research in the world. It address however questions on the ways to improve the transfer efficiency of the research work at the farmer's level.

A lot of efforts are and will be provided in the future inside Halhale Center to develop forage resource experimentation. How could the experimentation results and derivated innovations be more effectively integrated into local agricultural systems, be more adapted to local practices and correspond to farmers' strategies? It would be interesting to address more explicitly these questions and consider the way Halhale forage research strategy would be best fitted to overcome the problems of transfer inside future research and development programs.

An interesting question would be to evaluate how a centre like Halhale could relate the results generated inside the centre, where it is possible to measure accurately most of the important parameters of the system, with the perceptions, objectives and aims of the local farmers under similar conditions.

In bridging the gap between farmer's reality and the results produced inside the research centre, how could farmers be associated in discussions of proposed innovations when research

focuses more functional approaches[21] to feeding systems for herds than on particular solutions? Associating representative farmers in formulating questions and solutions, on station protocol building and results sharing inside the research system would be promising. Such an approach could constitute an intermediary and complementary step between on station, biophysical approaches and on farm PRA and extension work. By the way, it would reinforce the relevance of and justification for maintaining effective experimental facilities in local contexts of Eritrea.

It could also constitute a valuable resource for training activities based on concepts like the Livestock Farmers' Field Schools actually developed at ILRI (Minjauw *et al.* 2002)[22].

[21] Functional analysis of the feeding system is a concept that ahs been largely developed in the extension services for livestock producers in France. Tt proposes a global approach to system functioning according to perceptions of key periods and resource allocation to the herd during the year.
Information on the approach and examples adapted to local conditions can be found on internet sites like:
http://www.cra-mp.org/groupefou/j160697/g25_1.html
http://www.inra.fr/Internet/Produits/PA/an1997/tap1997/g2a971.pdf
The concept is not totally transferable as such, but adaptations could be developed for local situations.

[22] An extended description of the approach is provided on: http://www.eseap.cipotato.org/upward/Events/FFS-Workshop-Yogya2002/Draft-Wor

The On farm ruminant practices in the highlands of Eritrea study

Problematic

It is the one described here before, tending to show the need and interest of a first characterisation of the diversity of farming practices inside the crop livestock system of the Highlands zone of Eritrea. Considering this, a study including a practical training of a CNEARC student was proposed (see annex 1)

Overall description of the work planned during the support mission[23]

As far as transport means availability and administrative authorisation for access to the villages appeared problematic, the general framework of the study will be limited to 20 villages (or village communities) enquiry journeys aiming to degage in a rapid appraisal, for each villages the main quantitative indicators and a monography written according to synthetic description of:

- the agricultural systems / the livestock and feeding system, with calendars
- the inventory of the interaction between the systems
- the strategy of the farmer's along the last 10 years adaptation to drought
- intensification of particular compartments
- the perception of the equilibrium between collegial activities and the territory
- the prospective view of the farmers and their particular expectation and eventual receptiveness to simultaneous adaptation of the two systems.

Procedure

The work will limit itself to the highlands, and extend on 3 or 4 subzobas according to main agroecomogical shapes. Having contacted the administrator of the subzoba in each one 4-5 village are chosen. For each chosen village the village administrator will be interviewed to characterise the general features and retrieve the main descriptors.: (Cultivated land area, grazing land area, areas of land unit categories households, family size, animals / categories .....

Through interview with 2-3 selected farmers / village, the enquiry will help to finalise the indicators and collect the information necessary to describe the local systems and practices.

After each village enquiry journey, develop a 2 pages monograph with an introductory table of main indicators and a text on each items.

23 It has to be said that the proposed subject was not totally welcomed by the livestock unit head, at the arrival of the trainee, the argument being that the systems was already characterised and that there was no particular competencies or interest on such approaches inside the institute. As far as it had been planned in the frame of the Scac support convention with Cirad it was difficult to consider totally different options. The Center confirmed however it's acceptation of the study course and two young scientists were committed to form a team with the French student.

Statistical data analysis on the main indicators should be realised to develop a grouping of the village according main indicators analysis the groups should be summarised and contribute to a discussion of the variability and the options for future research work.

CONCLUSIONS

Technical solutions exist for the alleviation of main limiting constraints in dairy or crop livestock systems in Eritrean Highlands and research work at the Halhale station already participates in providing such solutions.

The Centre is recent and progressively builds it's pool of competencies. It is highly demanding international collaboration with other scientific institutions for the sharing of available scientific information, for scientific partnership on innovant approaches and for international reconnaissance.

The actual livestock research approaches, if they are scientifically relevant in the field of animal science, will always have poor adoption potential if they are not carefully accompanied with steps identifying the social and organisational aspects, and also if these are not at the start effectively associating the end users to the innovation building process.

There are no well tried and tested scientific methodologies to achieve such goals. It is mainly a question of communication and awareness-building and of finding ways to effectively associate Halhale livestock competencies in larger partnership with other institutions around a common challenge of finalised adoption of proposed solutions.

Actual work mainly needs to be scaled to farm and farmer's dimensions and accompanied with a more system functioning approach.

As far as strong collaborations appear to already exist and to be continued between Halhale center and the FAO supported project (GCP/ERI/001/ITA, intended phase 2) the nutrition and forage research work initiated by Dr Tesfai Tseggai and Dr Kayouli should be continued and support actions from SCAC should be build in partnership and narrow concertation with this action.

A concerted action plan should also be implemented with extension services and the Livestock development project housed at Agricultural Promotion and development department.

- In this view it could an interesting starting initiative from MAE SCAC to support in near future the organisation in Asmara of a workshop on Livestock productions. Gathering all local stakeholders and potential partners it would be helpful to develop a state of the art on the perspectives and problematics and conceive common strategies to promote livestock production R &D actions in Eritrea

In future French MAE FSP support action, on the more particular aspect of resource management and animal nutrition research, specific programs of collaboration could be developed between Halhale Center and CIRAD on the following topics:

<u>Quality of forage and feeds</u>

- As part of a longer term strategy of laboratory networking a first step for collaboration with CIRAD could consist in the organisation of two month operational stays of researchers in the Montpellier laboratory, for initial training on the main lab methods.

- As soon as the laboratory infrastructure will be totally completed in Halhale, the proposal of a expert technical support from Cirad, for the starting of the different equipment is also to be maintained.

Like other regional or international laboratories, Halhale nutrition laboratory will develop collections of samples referenced for chemical composition and feeding value. Classically these samples are kept during a few months or more, for eventual control, and then are generally destroyed. Near Infrared Spectrometry techniques are affordable and a good mean to preserve and long term capitalise on all the information contained in the samples. [24].

- Many laboratories are actually investing in such equipment and it could be part of a future support project to associate such potential to the equipment of the Halahale nutrition lab.

The CIRAD nutrition laboratory is actually developing Near Infrared Spectroscopy calibrations for fast, accurate and low cost prediction of the feeding values of tropical resources. To render the calibrations more robust and applicable in differing contexts, the databases should be extended to larger sets of referenced forages, feeds, by products, forage trees, and so on...Collaboration with Halahale on such action would be welcomed. In parallel a complimentary strategy is progressing step by step to develop a NIRS network that would link laboratories in the tropics (East Africa, Indian Ocean, West Indies), within which partners could exchange spectral data and quality prediction of feeds and forage on the Internet. Halhale lab could be a real partner for such future networking action.

Animal needs and nutritional adaptation in harsh environments

The Animal Production Program of Cirad EMVT is largely investing in tropical milk production research and actions through the CIRAD TROPMILK group initiative.

- The dairy activities in Eritrea and the research facilities in Halhale would totally justify more structured collaboration for future research, particularly on the aspects of the evaluation of feeding strategies follow up methodologies. These aspects still need to be more deeply documented in the modelling of recommended dairy feeding systems adapted to the types of animals and to the environmental constraints of these regions.

Resource management – Crop & livestock integrated systems

From a similar perspective, in order to connect tropical milk development issues and resource management, more references need to be acquired in terms of appropriate conservation technologies and technical protocols, identification of constraints to adoption, and functional analysis of resource management.

Under the thematic area of the sustainable integration of crop and livestock systems, soil fertility restoration, key farming practices, innovative no tillage and direct mulch cover seeding systems, many new questions in terms of interactions and synergy optimisation between cropping and livestock management practices should be addressed. For example, relevant protocols for forage exploitation are needed to develop dual purpose forage parcels

[24]NIRS is a fast, low cost and non destructive analysis technique, well adapted to the qualification of organic compounds. The general principle is to apply mathematical models of the chemical composition of referenced samples to their NIR absorbency spectra, and then use these models to predict the composition of unknown samples. Many such approaches have been developed in northern countries and NIR has become a routine, low cost technique for the evaluation of feeds and forages

on which resources are partly collected for animal feeding and partly preserved as biomass for coverage in direct mulch cover in a seeding rotational system.

- The Halhale centre could effectively participate in the future to developing approaches on these emerging subjects. Close collaboration for example with G. Rippstein, actually at ISRA Senegal with long-term expertise on these forage management options, should be developed on these particular questions. The positioning in CIRDES of two CIRAD livestock and agro pastoralism scientists (E. Vall and J. Cesar) after September of this year will also offer a real opportunity to develop collaboration on these two thematic areas of resource management and crop/livestock system approaches.
- In a same way the recent positioning of a researcher, P grimaud, at the Makarere university (Ouganda) in backstopping to the SCAC project supporting the emergeance milk farmer's organisations in Mabara is also a real opportunity for more international collaboration between Eritrea and countries of the region and more particularly for the organisation of training activities in a English speaking country. Trough the MAE SCAC, contacts should rapidly take place between the institutions to further elaborate on the specific topics for collaboration that could be developed.

Even if such particular research is essential for future technical development profiling in the crop livestock systems, further on farm studies on the livestock management practices and diversity analysis in the highlands agricultural systems should not be directly renewed in the near future as far as, for the moment, the Centre doesn't share a real enthusiastic interest on these sociotechnical research questions. The initiative was probably a step too far, the organisation of a workshop on Livestock productions could be a necessary preliminary step to discuss such research opportunity and share a common concern on the interest and means to allocate to such actions.

If trainings for young students are to be organised in future support action it would be better to center the activities on very specific technical development (nutrition or more probably health lab development)

Training activities

In Eritrea this particular aspect will be a main pillar for future R&D activities.

- Related to needs expressed in terms of on farm protocol building, statistical experimentation, data treatment, the expertise of S. Messad (EMVT PA Modelling Team) in statistical training could also be shared in a specific 10 days mission centered on data treatment.
- Along to such local support action a long term plan should be build for the abroad training and post graduating of the young researchers in the thematic field of resource agronomy, animal nutrition, system analysis. The positioning of a Cirad researcher at the MUK (Ouganda) could be of great help to facilitate the organisation of such contacts.
- In relation with technology transfer and on field training of the farmers, it would also be interesting to develop joint research actions between Halhale Center, CIRAD and ILRI on innovative approaches adapted to the specific implementation of cattle nutrition questions, and resource management on concept and methods for Participatory Research Action and more specifically for emerging R&D strategies for the Livestock Farmers Field Schools. This will also soon be part of the questions

addressed in the research program that E. Vall will develop in CIRDES (Burkina Faso) on support services for draft animals and milk livestock small holders. As has been indicated for the crop livestock research aspects, contacts should rapidly take place between the institutions to identify specific proposals for collaboration.

Many collaboration points are possible in support to Research on nutrition and forage for livestock. It focuses here on the dairy and crop livestock of the Highlands. It should also be kept in mind that the largest part of the cattle is in the lowlands and face very acute health, resource and water constraints. In future FSP support actions Eritrean R&D could also take great opportunity of the expertise existing in CIRAD on pastoralism in the dry zones, A mission of experts from PPZS (Dakar) on the evaluation of potential collaborative programs is also recommended.

References

Chedly Kayouli, Tzeggai Tesfai and Assefaw Tewolde, (2003) FAO Country Pasture/Forage Resource Profiles, Eritrea. http://www.fao.org/ag/AGP/AGPC/doc/Counprof/Eritrea.htm

Kayouli, C. and Assefaw, T. 1999. *Fourth Advisory Mission on : Appropriate Research and Development Programme in Animal Nutrition & Animal Production Systems* (Italian Trust Fund Project "Strengthening Agricultural Research and Extension in Eritrea" (GCP/ERI/001/ITA). FAO-Asmara, May 1999.

Kayouli, C. and Assefaw, T. 2000. *Fifth Advisory Mission on : Appropriate Research and Development Programme in Animal Nutrition & Animal Production Systems* (Italian Trust Fund Project "Strengthening Agricultural Research and Extension in Eritrea" (GCP/ERI/001/ITA). FAO-Asmara, October 2000.

FAO 2000. Worldwide agroclimatic database, FAO clim2 ver 2.01 FAO agrometeorlogy goup, Rome

Sumberg J. , 2002, Livestock nutrition and foodstuff research in Africa: when is a nutritional constraint not a priority research problem? Animal Science, 75:332-338.

Chapko, L.B., M.A. Brinkman, and K.A. Albrecht. 1991. Oat, oat-pea, barley, and barley-pea for forage yield, forage quality, and alfalfa establishment. J. Prod. Agr. 4:486-491.

Organisation and persons contacted

ORGANISMES	PERSONNALITÉS	FONCTION EXERCÉE
Ambassade France SCAC	P. Montaigne	Conseiller SCAC
Ambassade France	M Arrault	Assistant SCAC
Minagri Dpt research	Asmeron Kidane	Director of research
Minagri Dpt recherche	Tzeggai Tesfai	Head Livestock Unit
Minagri Dpt research	Tesfaslassie Gimariam	Head of agronomy and plant genetics unit
Minagri Dpt research	Ahmedin Ismael	Head Agricultural engineering unit
Min Agric APDD	Kahsay N.G.	Counsellor/ Livestock project
Minagri Dpt recherche	Eskindir Tesfai	Livestock unit research
Minagri Dpt recherche	Tedros Tsehaye	Livestock unit research
France Cnearc	Thomas Pomeon	stagiaire
Minagri Dpt recherche	Kahsay Andegergish	Livestock unit research
Minagri Dpt recherche	Haile Baraki	Livestock unit research
Minagri Dpt recherche	Dr.Teklehaimanot Gebreselassie	Livestock unit research
Minagri Dpt recherche	Goitom	Livestock unit research
Minagri Dpt recherche	Daniel Yinabi	Livestock unit research
Minagri Dpt recherche	Girmai Abraham	Livestock unit research
Minagri Dpt recherche	Weldu Teklemicael	Livestock unit research

Annexes 1

CIRAD-EMVT's PROPOSAL
to
Service de Coopération et d'Action Culturelle (SCAC)
Ambassade de France en Erythrée
for
a Co-operation with the Livestock Research Unit

TERMS OF REFERENCE :

RESEARCH PROGRAMME OF YOUNG SCIENTISTS ON FARM RUMINANT FEEDING PRACTICES IN THE HIGHLANDS OF ERITREA

Background :
The SCAC of the French Embassy in Eritrea plans to devote a certain amount of its 2003 budget (Titre IV) to start cooperation activities in the field of livestock (production, health and research), in the aim to help the country in strengthening animal production and improving food security by livestock rearing. This cooperation is a first step in the construction of a partnership between French and Eritrean institutions and could lead to further activities in a possible future pluriannual programme.

Objectives of research:
To realize a study on the farm feeding practices in the highland (Asmara region), especially to supplement ruminants during the end of dry season and/or to intensified production (dairy, fattening). A special attention will be given to the production of fodder (rain fed or irrigated), the chemical treatment of straw, the mineral complementation and the use of by-products.
The results of this study will help the scientists of the Research Centre to refine the programme of introductions and experiments on fodder plants. An other result will be a better information of the farmers on the use (or possible use) of fodder plants and by-products to improve the ruminant feeding during the dry season or for semi-intensive production.

Tasks:
Participate to a team of young scientists under supervision of a researcher of the Centre. Organise the programme of visits, elaborate the questionnaire and the sampling of farms, make the survey in farms. Analyse the data. Discuss the results with the relevant scientists. Write in collaboration the main results in papers to be published.

Conditions of training:
Under responsibility of the head of the Livestock research unit, the team will work in the office of the Agronomic Research Centre of Halhale, 30 km from Asmara. For the field visits, a vehicle will be rented by French Embassy. The Research Centre will arrange the daily transport to Asmara.

Date and duration:
Five months from April to August 2003.

Annexe 2 :List of forage seeds producers

AUSTRALIA

Agricultural Seeds PTY. Ltd
Cr. Anzac Avenue and Ball Street
P.O.Box 1052
Toowombaa Qld 4350 AUSTRALIA
Phone :(076) 30 1000 fax : (076) 30 1005

Selected seeds catalogue
Export Division :
59 Drayton Road
P O Box 7882
Toowomba Mail Centre 4352
Queensland . AUSTRALIA
Phone 61-7- 4636 0300 Fax : 61-7-4636 0311

Heritage seeds Pty Ltd consult web site for catalog
P.O. Box 76
Brisbane Markets QLD 4106. AUSTRALIA.
Phone : 61-7-3216-6983 Fax : 61-7-3216 6985
E mail : export@heritageseeds.com.au
Web site : http://www.heritageseeds.com.au/

Pacific seeds
A.C.N. 010933061
268 Anzac Avenue, P.O. Box 337
Toowoomba Queensland , AUSTRALIA. 4350
Phone : +61 76 902 666 Fax : + 61 76 302 826
Web site : www.pacificseeds.com

SAUERS
25, Stanley Street , P.O. Box 117
ROCKAMPTON, Queensland 4700
AUSTRALIA
Phone : 079 27 33 33 Fax : 079 22 22 19

Australian Revegetation Corporation Ltd
KIMSEED
42, Sarich Court
Osborne Park 6017
WESTERN - AUSTRALIA
Tél : 19 (09) 446-4377
Fax : 19 (09) 446-3444

Williams
JH&EJ Williams PTY. LTD
P.O. Box 102, Murwilumbah N.S.W.2484
AUSTRALIA
Tel : (02) 66 72 1313 facsimile : (02) 66 72 3466
Int : (61) 2 66 72 3466
Email : Seed Division : Williams.seed
@omcs.com.au
Email:Head Office :
JHWillams.murbah@omcs.com.au

Progressive seeds PTY. LTD.
P.O. Box 10 Mt Crosby Q. 4306
Australia
Tel : 617 3201 1741
Fax : 617 3201 1006
email : pseeds@cynergy.com.au

SENEGAL
ISRA/CNRA
BP. 53 - Bambey SENEGAL Niébé
Tél : (221) 73.60.50
Fax :(221) 73.61.97

ENSA de THIES
Département des Sciences et techniques de production animale
BP. A296 - Thies SENEGAL
Pr A. DIENG.

ETHIOPIE

ILRI

P.O. Box 5689 - Addis Abeba .
Tel : 251 1 613215 extension 138
Contact Jean Hanson
j.hanson@cgiar.org

THAILANDE
Pacific Seeds (Thaï) Ltd
1 MO 13 (P.O. Box 15)
Phraphuttabat, Saraburi
18120 THAILAND
Phone : +66 36 266097, 266316-9,267877-8
Fax : + 66 36 266508

INDE
Harsh Kumar
Shivalik Seeds Corporation
47, Panditwari, PO Prem Nagar
Dehradun _ 248007, U.P., INDIA
Tel : 91 135 773348
Fax : 91 135 773776
E-mail : hilander@vsnl.com

COLOMBIE
CIAT. Centro International de Agricultura Tropical
Apartado Aéréo 6713, Cali COLOMBIA .
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Sao Paulo
BRAZIL
Fax/phone : 55 18 2211133

Sementes NATERRA
Nacional de Sementes Commerciale
Importadora Ltda.
Avenida Marechal Costa e Silva
N°4.356 - CEP. 14.075
Ribeirao Preto - SP
BRAZIL
Mail : naterra@netsite.com.br

INDIA

HARSH KUMAR
Shivalik Seeds Corporation
47,Panditwari,P.O. Prem Nagar
Dehradun-24807,U.P.,INDIA
Tel : 91 135 773 348
Fax : 91135 773 776
Email : hilander@del2.vsnl.net in

KENYA

ICRAF
P.O. Box30677, Nairobi,KENYA semences d'arbre (4000 espèces)
Tel : +254 2 521450 (or)+ 1 650 833-6645
Fax : +254 2 521001 (or)+1 650 833-6646

ILRI
P.O. Box 30709 Nairobi KENYA
Tel : (254-2)630743
telex : 22040
Fax : (254-2)631499
E.Mail : ilri@cgnet.com
Website : htpp://www.cgiar.org/ilri

E.A.P.I.,P.O.
P.O. Box 90442 Mombasa KENYA
Tel : (254-1)225158
Fax : (254-1)227551

AUTRES PAYS

ITALIE

IPGRI
Via delle Sette Chiese 146 Germplasm documentation
00145 Roma
ITALIA
Phone : +39-0651892236
Fax : +39-065750309
Web : http://www.cgiar.org/ipgri

FAO échantillons, renseignements.
Service des semences
Via delleterme di Caracalla
00100 ROMA
ITALIA

SEMENCES TEMPEREES

FRANCE

Graines LORAS S.A.
Avenue de la Poterie
BP 50
69890 LA TOUR DE SALVAGNY
Tel : 04 78 48 02 40

RAGT diverses plantes tempérées mais aussi Sorghos
Les Molinières
12450 La Primaube
Tel : 05 65 73 41 00
Fax : 05 65 71 25 19

TECHNISEM Intermédiaire pour plantes tropicales
Avenue Garigliano. ZAC des gatines
91601 Savigny sur orge Cedex
Tel : 01 69 96 03 42
Fax : 01 69 96 86 01

Annexe 3 Selected Books according to their priority

1Field and Laboratory Methods for Grassland and Animal Production Research	120 $
2Forage Evaluation in Ruminant Nutrition	140 $
3Forage Seed Production Volume 2: Tropical and Subtropical Species	170 $
4Feeding Systems and Feed Evaluation Models	140 $
5Experimental Design and Analysis in Animal Sciences	045 $
6Poultry Feedstuffs: Supply, Composition and Nutritive Value	140 $
7Reproduction in Poultry	070 $
9Poultry Meat Science	130 $
10Poultry Production in Hot Climates	110 $
11Principles of Poultry Science	030 $
13The Advancement of Veterinary Science - Volume 1: Veterinary Medicine Beyond 2000	
14The Advancement of Veterinary Science - Volume 2: Veterinary Education: The Future	
15The Advancement of Veterinary Science - Volume 3: History of the Healing Professions	
16The Advancement of Veterinary Science Volume 4: Growth	110 + 110 + 85 + 110 $
17Grass for Dairy Cattle	125 $
19Genetic Improvement of Cattle and Sheep	045 $
20Competition and Succession in Pastures	120 $
21Controlled Reproduction in Cattle and Buffaloes	120 $
22Controlled Reproduction in Sheep and Goats	130 $
Revue Elev. et méd. vet. pays trop. 1947-2000 (Cdrom Cirad)	060 E
Jarrige R., 1988. Ruminant nutrition : recommended allowance and feed tables. John libbey eurotext, Paris, 389 p.(estimé)	100?
Payne W. J. A.,Wilson R. T., 1999. An introduction to animal husbandry in the tropics. Blackwell Scientific, Oxford (GBR), 5e ed., 816 p. (95 £)	180 $

Total (estimé)	2390 $
Expédition (estimé)	110
Total général (estimé)	2500 $